



Case review

Sudden death due to ruptured pseudoaneurysm of femoral artery in injected drug abusers – Report of four cases at autopsy and review of literature



C. Behera, MBBS, MD, Assistant Professor (Forensic Medicine)^{a,*},
 Sunil Naagar, MBBS, MD, Associate Professor (Forensic Medicine)^b,
 Karthik Krishna, MBBS, MD, Senior Resident (Forensic Medicine)^a,
 Danesh R. Taraporewalla, FRCPath, Consultant Histopathologist^c,
 G.V. Garudadhri, MBBS, MD, Ex-Senior Resident (Forensic Medicine)^b,
 Kulbhushan Prasad, MBBS, MD, Ex-Senior Resident (Forensic Medicine)^b

^a Department of Forensic Medicine, All India Institute of Medical Sciences, New Delhi 110029, India

^b Department of Forensic Medicine, Maulana Azad Medical College, New Delhi, India

^c Department of Histopathology, Chesterfield Royal Hospital NHS Foundation Trust, Calow, Chesterfield S44 5BL, United Kingdom

ARTICLE INFO

Article history:

Received 9 May 2013

Accepted 7 December 2013

Available online 18 December 2013

Keywords:

Pseudoaneurysm

Femoral artery

Injected drug abuse

Sudden death

ABSTRACT

Pseudoaneurysm in injected drug abusers occurs due to traumatic damage by the repeated injections and infections. It most commonly involves the femoral artery that requires intensive management. When medical attention is delayed, the victim is prone to have massive bleeding from the ruptured artery, resulting in death. Although pseudoaneurysms in injected drug abusers are known, there is paucity of autopsy study on sudden deaths due to its rupture. We report four such cases with different presentations of the pseudoaneurysm that had ruptured spontaneously. The paper highlights the case history and autopsy findings of these cases with review of literature of this catastrophic event in injected drug abusers.

© 2013 Elsevier Ltd and Faculty of Forensic and Legal Medicine. All rights reserved.

1. Introduction

Injected drug abuse is associated with wide variety of complications like bleeding from the site, frequent infections including bacterial endocarditis, hepatitis, thrombophlebitis, pulmonary emboli, ulceration, cellulitis, scarring, deformity, gangrene, cardiac failure, hepatic failure etc.^{1–4} With increased abuse of injectable drugs like heroin and also due to easy availability of prescription drugs, the complications of vascular diseases is taking its importance.^{5–7} The arterial disease due to injected drug abuse precipitated by local and systemic infection results in mycotic pseudoaneurysm.^{8–10} Though pseudoaneurysm of femoral artery in injected drug abusers is known,¹¹ sudden death due to ruptured pseudoaneurysm is a rare phenomenon and there is lack of autopsy studies on this topic. Here we are reporting 4 cases of fatal

pseudoaneurysm of femoral artery in injected drug abusers and discuss the emerging problem.

2. Case presentation

2.1. History and autopsy findings

2.1.1. Case 1

A 45 year old, unidentified male presented to emergency with pain at the inguinal region. He was conscious, oriented, afebrile and hemodynamically stable. On local examination, a red pulsatile swelling was seen in left inguinal region. Emergency Doppler ultrasound of the left inguinal swelling showed a pseudo-aneurysm arising from lateral wall of common femoral artery. Distal part of arterial tree showed normal flow. Hematological studies showed hemoglobin 10.3 g%; white blood cell count 10,300/micro liter. Serological tests for HIV, Hepatitis were found to be negative. A compression bandage was applied on the wound site and antibiotics, analgesics administered. He was

* Corresponding author. Tel.: +91 9968320486; fax: +91 11 26588641.

E-mail addresses: drchitta75@rediffmail.com, drchitta75@yahoo.co.in (C. Behera).

advised to keep the lower limb elevated. On the following morning, a day after admission, he developed spontaneous and extensive bleeding from the aneurysm site and developed cardiac arrest. Cardio Pulmonary Resuscitation was done but could not be revived and was declared dead.

At autopsy, a wound of size 2.5 cm × 1.3 cm was present over left inguinal region, 5 cm below and outer to pubic symphysis (Fig. 1). The wound was surrounded with swelling over an area of 5 × 3 cm. The surface of wound was covered with clotted blood and surrounded by purulent material. On removing the clot, a defect of 3 × 3 mm was found in the lateral wall of the femoral artery. Rest of the arterial tree was normal. On internal examination, organs were pale. There was no aneurysm present in other blood vessels. Gross examination of the femoral artery showed discontinuity of vessel wall surrounded with hematoma (Fig. 2). Microscopic examination of soft tissues from inguinal region revealed infiltration of acute inflammatory cells into fibro-fatty and fibro-skeletal tissue (Fig. 3). The wall of femoral artery infiltrated with acute inflammatory cells with formation of pseudo-aneurysm. The wall of the common femoral artery showed destruction and it was surrounded by bacterial colonies, areas of hemorrhage and acute inflammatory cells.

2.1.2. Case 2

A 32 year old unidentified male was found unconscious on the road side with blood stains on his clothes. He was brought to hospital by the police where he was declared brought dead. The police revealed that the deceased was a known injectable drug abuser (dextropropoxyphene).

At medico-legal autopsy, it was observed that the victim's clothes were stained with blood. Postmortem lividity was faint. Multiple scar mark present over chest, abdomen, back of trunk and upper limbs. An indurated area of size 0.3 × 0.2 cm with multiple injection mark was present over the left upper thigh 3.7 cm below the left mid inguinal point. A non healing ulcer of 5 cm × 4 cm present over the anterior part of left leg in middle 1/3rd. A swelling of size 4.5 cm × 4.2 cm with central defect, blood clot on surface was present over the right upper thigh, 3.5 cm below right mid inguinal point, 9 cm below the right anterior superior iliac spine (Fig. 4). On further exploration, fibrous muscular swelling of size 2.5 cm × 2 cm was found attached to the anterior wall of right femoral artery. The wound tract extended through fibro muscular growth and continued into the lumen of right femoral artery with effusion of blood present in the surrounding muscle and tissue. All the organs were pale. The cause of death was hemorrhage and shock consequent upon rupture of pseudoaneurysm of right femoral artery.



Fig. 2. Gross dissection demonstrating the ruptured femoral artery.

2.1.3. Case 3

In this case, victim was a 30 year old, unidentified male who was found dead in a pool of blood on the road side. According to the police, he was a chronic injectable drug abuser. At autopsy, his inner wear was soaked with blood. There were dried blood stains around the inguinal and pubic region. An indurated area of 2 cm × 1.5 cm with a non-healing ulcer of size 1.5 cm × 1.5 cm was present over the anterior part of left inguinal region surrounded by area of fibrosis (Fig. 5). On exploration of the wound, there was a tract extending to the left femoral artery with clotted blood around the site. All organs were pale and cause of death was hemorrhage and shock consequent upon rupture of pseudoaneurysm of left femoral artery.

2.1.4. Case 4

A 31 year-old male who had a history of chronic intravascular drug abuse was noted to have a deep infected wound on the right groin, which he kept scratching. On the fateful day he was walking



Fig. 1. Pseudoaneurysm of left femoral artery.

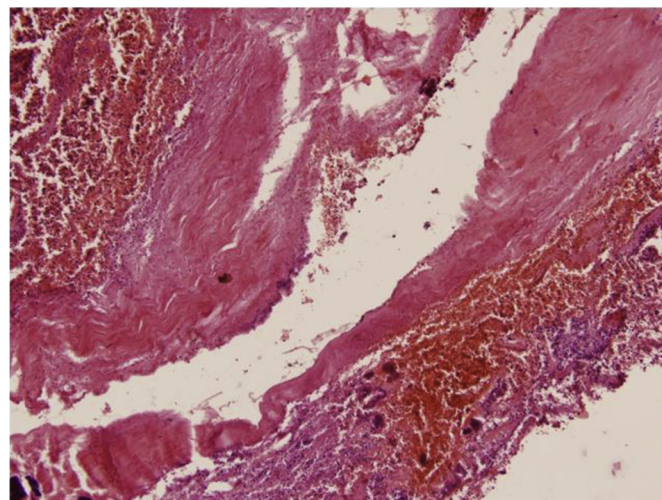


Fig. 3. Histopathology of femoral artery showing necro-inflammatory changes.



Fig. 4. Pseudoaneurysm of right femoral artery.

out of the toilet, when his partner heard a popping noise and bleeding started from his right groin site. His partner tried to stem the flow with towels till the arrival of paramedics. Ambulance paramedics arrived at which point the patient was unconscious with a Glasgow coma scale (GCS) of 3. There was pulseless electrical activity noted, while he was being taken to hospital casualty. As it was not possible to get vascular access, left femoral cut down was performed. No cardiac output was noted. Cardio pulmonary resuscitation was stopped and he was declared dead.

At autopsy, there was pseudo-aneurysm of right femoral artery, which at the anterior aspect was in continuity with the skin ulceration and clot formation (Fig. 6). Dried blood stains were present around the wound site at the right inguinal region.

Summary of the four cases are mentioned in table (Table 1).

3. Discussion

Pseudoaneurysm is the term designated for an aneurismal sac, when only a single layer of fibrous tissue is present in its wall.¹² Pathologically, the wall of arterial pseudoaneurysm has been breached, and the external wall of the aneurismal sac consists of



Fig. 5. Pseudoaneurysm of left femoral artery with dried blood clot.



Fig. 6. Pseudoaneurysm of right femoral artery with vessel wall exposed to skin surface.

outer arterial layers, perivascular tissue, blood clot, or layer of reactive fibrosis.¹³ The common vessels site for pseudoaneurysm is femoral artery followed by abdominal aorta, superior mesenteric, brachial, iliac and carotid artery.¹⁴ Because of the localization of the common femoral artery inside a neurovascular sheath and support of the head of the femur, the chances of common femoral artery as a puncture site is more common than superficial femoral artery.^{15–17} The cause of pseudoaneurysm is often iatrogenic and may occur following percutaneous cannulation, or graft dysfunction.^{18,19} Common etiologic factors include host vessel degeneration, femoral triangle sepsis, prosthetic dilation & suture deterioration. Other risk factors include use of large-bore catheters, female gender, use of anticoagulant, thrombolytic agents, and inadvertent cannulation of deep femoral or superficial artery.^{20–23} Pseudoaneurysms secondary to trauma can also occur from penetrating or blunt trauma as in gunshot injuries, stab wounds, and motor vehicle crashes.²⁴ However, current literature suggests that both the incidence and complications of pseudoaneurysm of femoral artery due to injecting drug abuse is on the rise.^{9,25–29} The pseudoaneurysm that is secondary to injected drug abuse is more complicated, as it is frequently accompanied by infection, owing reuse of syringes and already damaged vessel wall.³⁰ Maliphant et al. (2005) studied on rationale regarding groin injecting in femoral region and found out that reasons for use of this particular site were due to convenience, utility, ease of use and reduced risk of losing the euphoric effects due to extravascular delivery.³¹

Deaths due to rupture of femoral artery pseudoaneurysm among the injecting drug abusers are rarely found in scientific literature. Behera et al. (2011) reported a case of ruptured left common femoral artery in a 30 year old unknown drug abuser belonging to low socioeconomic status who had died at hospital. Later medico-legal autopsy was conducted as the deceased was unknown and unidentified and also gave history of trivial trauma. This was the first reported case in forensic literature.¹⁴ Later, Lardi et al. (2012) also reported a similar case of death due to spontaneous rupture of pseudoaneurysm of right common femoral artery in a 38 year old drug abuser who was found dead at his home.³²

In our case series, three were reported from India and one case reported from United Kingdom. All the victims had history of injectable drug abuse. One case presented with pulsatile groin mass, another presented with deep infected wound with pruritis and sudden bleeding. Three cases reported from India were medico legal in nature as two of them were unidentified, one of the victims was found dead; however all deaths were related to drug abuse.

Table 1
Summary of cases.

Cases	1	2	3	4
Age (Years)	45	32	35	31
Sex	Male	Male	Male	Male
Built	Thin	Thin	Thin	Average
Identification	Unknown	Unknown	Unknown	Known
Socioeconomic status	Low	Low	Low	Middle
History of injection to Femoral Artery	Positive	Positive	Positive	Positive
Alleged drug of abuse	Dextropropoxyphene	Dextropropoxyphene	Dextropropoxyphene	Heroin and methadone
Spontaneous bleed	Yes	Yes	Yes	Yes
Sought medical attention	Yes	No	No	Yes
Sudden death	Yes	Yes	Yes	Yes
Death occurred at	Hospital	Found dead on road side	Found dead on road side	Home

Pseudoaneurysm of femoral artery can present with progressive, painful and pulsatile swelling in the femoral region. As the incidence is usually secondary to iatrogenic intervention, early clinical suspicion is mandated. Once such pseudoaneurysm ruptures externally, there is acute vascular collapse due to large volume of blood loss. Apart from early recognition and compression of site of rupture, ultrasound-guided compression repair remains the first line treatment for femoral pseudoaneurysms. Ultrasound-guided thrombin injection has also supplemented techniques like emergency stenting of ruptured femoral artery.^{33–35} Literature review shows arterial reconstruction using grafts or ligation has also been used successfully in cases of ruptured femoral artery pseudoaneurysm.^{29,36–43}

In all our cases, there was development of mycotic pseudoaneurysm. Mycotic pseudoaneurysm occurs most commonly due to staphylococcus aureus due to seeding of bacteria directly into the injection site.¹¹ Systemic viral infections like hepatitis and human immuno virus can also be contacted by sharing of needles which contribute to the formation of mycotic pseudoaneurysm.

The duration between the terminal event of rupture of pseudoaneurysm and death in all the four cases were within 24 h denoting the suddenness and high fatality of the condition. In two cases, clinical diagnoses of pseudoaneurysm were made, however medical interventions were too late and victims succumbed to death. It was observed that in all the cases, the victims were adults belonging to male sex. Among the victims, three belonged to low socioeconomic status. Dextropropoxyphene was found to be the drug of abuse in three cases, heroin and methadone found in one case. The abuse of drugs for recreational purpose usually begins at adolescent and younger age group due to curiosity and peer pressure however the complications due to chronic/long term abuse can present later in adult age group. These observations are in connivance with many studies on the factors affecting the drug abuse and its complications.^{44–47} The injectable route of drug administration is known to produce faster and more effects to the abuser and is hence preferred.^{48,49} At the same time, the complications associated with injected forms are also life threatening. Males outnumber females in injected drug abuse and hence complications might also be reported more in them. As the victims belong to poor socioeconomic status, they can afford only cheap drugs and dextropropoxyphene is one such drug which is available in India as injectable form, at a low price, over the counter without any prescription. Dextropropoxyphene is an analgesic that belongs to class of diphenylpropylamine derivative opiod which is used to relieve mild to moderate pain. It is however not marketed in United States and Europe due to its abuse potential.⁵⁰ The pattern of abuse in our study is similar to the study conducted in India by World Health Organization among 5800 injected drug abusers.⁵¹

Rupture of pseudoaneurysm can occur spontaneously as in connective tissue disorders or congenital arterial abnormalities or

due to trivial trauma,^{52–54} however in our cases it was spontaneous and sudden in onset. The abusers may give history of trauma to the region while presenting at the hospital to conceal their habit of drug abuse.

4. Conclusion

Pseudoaneurysm is an emerging and under reported fatal arterial complications of injected drug abuse. In our series of cases, it is clear that there was no attempt to rehabilitate and complete failure of preventive strategies against the hazard of drug abuse. It was observed that though intervention in the form of medical help could be obtained in some cases, yet it was too late and too little. The authors are of the opinion that there should be restriction of over the counter sale of abuse-potential drugs in countries like India and the physicians should look for complication of aneurismal rupture in high risk individuals and manage without delay. There is also a need for widespread awareness against the drug abuse which can effectively curtail these kinds of complications.

Ethical approval

None declared.

Funding

None.

Conflict of interest

There is no conflict of interest in publishing this article.

References

1. Drug dependence. In: MedlinePlus Medical Encyclopedia. <http://www.nlm.nih.gov/medlineplus/ency/article/001522.htm>. [accessed 25.02.13].
2. Stein MD. Medical complications of intravenous drug use. *J Gen Intern Med* 1990;5(3):249–57.
3. Cherubin CE, Sapira JD. The medical complications of drug addiction and the medical assessment of the intravenous drug user: 25 years later. *Ann Intern Med* 1993;119(10):1017–28.
4. Roszler MH, McCarroll KA, Donovan KR, Rashid T, Kling GA. The groin hit: complications of intravenous drug abuse. *Radiographics* 1989;9(3):487–508.
5. Al Zahrani HA. Vascular complications following intravascular self-injection of addictive drugs. *J R Coll Surg Edinb* 1997;42(1):50–3.
6. Yeager RA, Hobson 2nd RW, Padberg FT, Lynch TG, Chakravarty M. Vascular complications related to drug abuse. *J Trauma* 1987;27(3):305–8.
7. Coughlin PA, Mavor AID. Arterial consequences of recreational drug use. *Eur J Vasc Endovasc Surg* 2006;32(4):389–96. <http://dx.doi.org/10.1016/j.jevs.2006.03.003>.
8. Bowden DJ, Hayes PD, Sadat U, Choon See T. Mycotic pseudoaneurysm of the superficial femoral artery in a patient with Cushing disease: case report and literature review. *Vascular* 2009;17(3):163–7.
9. Jayaraman S, Richardson D, Conrad M, Eichler C, Schecter W. Mycotic pseudoaneurysms due to injection drug use: a ten-year experience. *Ann Vasc Surg* 2012;26(6):819–24. <http://dx.doi.org/10.1016/j.avsg.2011.11.031>.

10. Cury MVM, De Campos MH, Dos Santos DP. Salmonella-related mycotic pseudoaneurysm of the superficial femoral artery. *Int J Surg Case Rep* 2011;**3**(1):27–9. <http://dx.doi.org/10.1016/j.ijscr.2011.10.009>.
11. Tashtoush B, Gonzalez-Ibarra F, Abed M. Mycotic pseudoaneurysm of the femoral artery in a patient with psoriasis. *Intern. Med.* 2012;**51**(19):2831–4.
12. Brunicaudi FC. *Schwartz's principles of surgery*. 8th ed. The McGraw-Hill Companies; 2007. p. 732.
13. Schoen FJ, Cotran RS. Blood vessels. In: Cotran RS, editor. *Robbins pathologic basis of disease*. Philadelphia, PA: Saunders; 1999. pp. 493–542.
14. Behera C, Garudadhri GV, Kulbhushan, Sunil. Fatal pseudo aneurysm in common femoral artery a case report. *J Indian Acad Forensic Med* 2011;**33**(1):80–2.
15. Fellmeth BD, Roberts AC, Bookstein JJ, Freischlag JA, Forsythe JR, Buckner NK, et al. Postganglionic femoral artery injuries: nonsurgical repair with US-guided compression. *Radiology* 1991;**178**(3):671–5.
16. Lacy JH, Box JM, Connors D, Penney L, Wright CB. Pseudoaneurysm: diagnosis with color Doppler ultrasound. *J Cardiovasc Surg (Torino)* 1990;**31**(6):727–30.
17. Altin RS, Flicker S, Naidech HJ. Pseudoaneurysm and arteriovenous fistula after femoral artery catheterization: association with low femoral punctures. *AJR Am J Roentgenol* 1989;**152**(3):629–31. <http://dx.doi.org/10.2214/ajr.152.3.629>.
18. Lamb K. Pseudoaneurysm and arteriovenous fistula simultaneously after cardiac catheterization. *J Diagn Med Sonogr* 2007;**23**(4):208–11. <http://dx.doi.org/10.1177/8756479307304110>.
19. Zhou C, Langlois NE, Byard RW. Femoral artery pseudoaneurysm and sudden death. *J Forensic Sci* 2012;**57**(1):254–6. <http://dx.doi.org/10.1111/j.1556-4029.2011.01897.x>.
20. Tak ML, Tahir T. Iatrogenic pseudoaneurysm of femoral artery: case report and literature review. *Clin Med Res* 2003;**1**(3):243.
21. Kim D, Orron DE, Skillman JJ, Kent KC, Porter DH, Schlam BW, et al. Role of superficial femoral artery puncture in the development of pseudoaneurysm and arteriovenous fistula complicating percutaneous transfemoral cardiac catheterization. *Cathet Cardiovasc Diagn* 1992;**25**(2):91–7.
22. Fan P, Schwab S. Vascular access: concepts for the 1990s. *J Am Soc Nephrol* 1992;**3**:1–11.
23. Franklin JA, Brigham D, Bogey WM, Powell CS. Treatment of iatrogenic false aneurysms. *J Am Coll Surg* 2003;**197**(2):293–301. [http://dx.doi.org/10.1016/S1072-7515\(03\)00375-2](http://dx.doi.org/10.1016/S1072-7515(03)00375-2).
24. Feliciano DV, Mattox KL. Traumatic aneurysms. In: Rutherford RB, editor. *Vascular surgery*. Philadelphia, PA: Saunders; 1989. pp. 996–1003.
25. Ting AC, Cheng SW. Femoral pseudoaneurysms in drug addicts. *World J Surg* 1997;**21**(8):783–6. discussion 786–787.
26. Cheng SW, Fok M, Wong J. Infected femoral pseudoaneurysm in intravenous drug abusers. *Br J Surg* 1992;**79**(6):510–2.
27. Behera A, Menakuru SR, Jindal R. Vascular complications of drug abuse: an Indian experience. *ANZ J Surg* 2003;**73**(12):1004–7.
28. Psathas E, Lioudaki S, Karantonis F-F, Charalampoudis P, Papadopoulos O, Klonaris C. Management of a complicated ruptured infected pseudoaneurysm of the femoral artery in a drug addict. *Case Rep Vasc Med* 2012;**2012**:1–4. <http://dx.doi.org/10.1155/2012/434768>.
29. Naqi SA, Khan HM, Akhtar S, Shah TA. Femoral pseudoaneurysm in drug addicts—excision without revascularization is a viable option. *Eur J Vasc Endovasc Surg* 2006;**31**(6):585–7. <http://dx.doi.org/10.1016/j.ejvs.2005.12.011>.
30. Sueyoshi E, Sakamoto I, Nakashima K, Minami K, Hayashi K. Visceral and peripheral arterial pseudoaneurysms. *AJR* 2005;**185**(3):741–9.
31. Maliphant J, Scott J. Use of the femoral vein ('groin injecting') by a sample of needle exchange clients in Bristol, UK. *Harm Reduct J* 2005;**2**(1):6. <http://dx.doi.org/10.1186/1477-7517-2-6>.
32. Lardi C, Fracasso T. Spontaneous external rupture of femoral pseudoaneurysm. *Am J Forensic Med Pathol* 2012;**33**(4):319–21. <http://dx.doi.org/10.1097/PAF.0b013e3182518e47>.
33. O'Sullivan GJ, Ray SA, Lewis JS, Lopez AJ, Powell BW, Moss AH, et al. A review of alternative approaches in the management of iatrogenic femoral pseudoaneurysms. *Ann R Coll Surg Engl* 1999;**81**(4):226–34.
34. Szendro G, Golman L, Klimov A, Yefim C, Johnatan B, Avrahami E, et al. Arterial false aneurysms and their modern management. *Isr Med Assoc J* 2001;**3**:5–8.
35. Klonaris C, Katsargyris A, Matthaiou A, Giannopoulos A, Tsigiris C, Papadopoulou K, et al. Emergency stenting of a ruptured infected anastomotic femoral pseudoaneurysm. *Cardiovasc Intervent Radiol* 2007;**30**(6):1238–41. <http://dx.doi.org/10.1007/s00270-007-9080-z>.
36. Mullan MJ, Magowan H, Weir CD. Femoral artery necrosis due to parenteral intravascular drug misuse: a case report and literature review. *Ulster Med J* 2008;**77**(3):203–4.
37. Manekeller S, Tolba RH, Schroeder S, Lauschke H, Remig J, Hirner A. Analysis of vascular complications in intra-venous drug addicts after puncture of femoral vessels. *Zentralbl Chir* 2004;**129**(1):21–8. <http://dx.doi.org/10.1055/s-2004-44871>.
38. Peirce C, Coffey JC, O'Grady H, Aly S, O'Malley K, O'Donohoe M. The management of mycotic femoral pseudoaneurysms in intravenous drug abusers. *Ann Vasc Surg* 2009;**23**(3):345–9. <http://dx.doi.org/10.1016/j.avsg.2008.08.013>.
39. Mousavi SR, Saberi A, Tadayon N, Zeynalzadeh M, Kavyani A. Femoral artery ligation as treatment for infected pseudo-aneurysms, secondary to drug injection. *Acta Chir Belg* 2010;**110**(2):200–2.
40. Chan YC, Burnand KG. Management of septic groin complications and infected femoral false aneurysms in intravenous drug abusers. *Br J Surg* 2006;**93**(7):781–2. <http://dx.doi.org/10.1002/bjs.5452>.
41. Padberg Jr F, Hobson 2nd R, Lee B, Anderson R, Manno J, Breitbart G, et al. Femoral pseudoaneurysm from drugs of abuse: ligation or reconstruction? *J Vasc Surg* 1992;**15**(4):642–8.
42. Lashkarizadeh MR, Ashrafanguie M, Ashrafanguie M. Surgical management of femoral artery pseudoaneurysms secondary to drug abuse. *J Coll Phys Surg Pak* 2011;**21**(11):672–5. doi:11.2011/JCPSP.672675.
43. Huang B, Zhao J, Ma Y, Yang Y, Xiong F, Wu Z. Repair and reconstruction of infective femoral false aneurysm caused by drug injection. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2011;**25**(8):1001–3.
44. Grant BF, Dawson DA. Age of onset of drug use and its association with DSM-IV drug abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. *J Subst Abuse* 1998;**10**(2):163–73.
45. Boys A, Farrell M, Taylor C, Marsden J, Goodman R, Brugha T, et al. Psychiatric morbidity and substance use in young people aged 13–15 years: results from the child and adolescent survey of mental health. *Br J Psychiatry* 2003;**182**:509–17.
46. Merline AC, O'Malley PM, Schulenberg JE, Bachman JG, Johnston LD. Substance Use among adults 35 Years of age: prevalence, adulthood predictors, and impact of adolescent substance use. *Am J Public Health* 2004;**94**(1):96–102.
47. Fuller CM, Vlahov D, Arria AM, Ompad DC, Garfein R, Strathdee SA. Factors associated with adolescent initiation of injection drug use. *Public Health Rep* 2001;**116**(1):136–45.
48. Aich TK, Dhungana M, Khanal R. Pattern of buprenorphine abuse among opioid abusers in Nepal. *Indian J Psychiatry* 2010;**52**(3):250–3. <http://dx.doi.org/10.4103/0019-5545.70978>.
49. Novelli LA, Sherman SG, Havens JR, Strathdee SA, Sapun M. Circumstances surrounding the first injection experience and their association with future syringe sharing behaviors in young urban injection drug users. *Drug Alcohol Depend* 2005;**77**(3):303–9. <http://dx.doi.org/10.1016/j.drugalcdep.2004.08.021>.
50. Dextropropoxyphene. In: MIMS <http://www.mims.com/USA/drug/info/dextropropoxyphene/?type=full&mtype=generic#Dosage>. [accessed 4 April 7, 2013].
51. World Health Organization. *Regional office for South-East Asia. Report on people who inject drugs in the South-East Asia region*, ISBN 978-92-9022-370-2; 2010.
52. Alsmady M, Abdallah F, Shanti H, Samara O. Spontaneous femoral artery pseudoaneurysm in a young patient. *J Surg Case Rep* 2012;**2012**(10). <http://dx.doi.org/10.1093/ijscr/2012.10.18>.
53. Goh BKP, Chen CY, Hoe MNY. Bilateral spontaneous rupture of the muscular branch of the superficial femoral artery with pseudoaneurysm formation. *Ann Vasc Surg* 2004;**18**(6):736–9. <http://dx.doi.org/10.1007/s10016-004-0092-8>.
54. Siani A, Flaishman I, Siani LM, Mounayergi F, Zaccaria A, Schioppa A, et al. Spontaneous rupture of the superficial femoral artery treated via an endovascular approach. *Tex Heart Inst J* 2008;**35**(1):66–8.